Vortex matter in strongly-correlated superfluids

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Topological defects play a crucial role in shaping the properties and structures of various out-of-equilibrium physical and biological systems across a broad spectrum of scales. These systems range from planetary atmospheres and turbulent flows in classical and quantum fluids to the electrical signaling in excitable biological media [1]. In superfluids and superconductors, the motion of quantized vortices is linked to the onset of dissipation, which limits the superflow [2]. Comprehending vortex dynamics poses a significant challenge due to the intricate interplay among vortices, disorder, and system dimensionality.
We tackle this challenge by investigating vortex matter in planar homogeneous Fermi superfluids [3]. By engineering vortex configurations and monitoring their evolution through tracking vortex trajectories, we gain unparalleled control over vortex dynamics. This capability transforms our system into an ideal "quantum laboratory" for unraveling the fundamental nature of vortex-driven instabilities and dissipation [4,5]. Our research opens prospects for understanding vortex-matter phenomena in strongly correlated superfluids.

References

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